Kufa Journal for Nursing Sciences
Open Access Full Text Article
Publisher
University of Kufa, Faculty of Nursing

Received: 23 May, 2023
Accepted: 27 June, 2023
Published: 30 June, 2023
Vol. 13(1), 2023: 147 – 154
https://doi.org/10.36321/kjns.vi20231.12146
ORIGINAL RESEARCH

Intraoperative Use of Portable Wireless Dental X-ray with An Intraoral Sensor as a Guide in Reduction of Isolated Zygomatic Arch Fractures.

Mohammed Oday Falih [1], Ali Sh. Zayed [2], Mohammed Habeeb SafeAllah [3]

[1] *Department of Maxillofacial Surgery at Al-Wasity Teaching Hospital, Baghdad, Iraq.*
[2] *Department of Maxillofacial Surgery at Al-Wasity Teaching Hospital, Baghdad, Iraq.*
[3] *Department of Maxillofacial Surgery at Al-kindy Teaching Hospital, Baghdad, Iraq.*

CORRESPONDING AUTHOR: Mohammed Oday Falih, Oral and Maxillofacial Surgeon, Department of Maxillofacial Surgery at Al-Wasity Teaching Hospital, Baghdad, Iraq.
Email: **Mohammedfalih1987@gmail.com**

ABSTRACT

Background: The second most frequent site for face bone fractures is the zygomatic arch. Because of its anatomical prominence, zygomatic bone fractures are becoming more common. Since the fracture lines cannot be seen clearly in closed reduction, the fragments are clinically repositioned using digital exploration and crepitus noise or traditional radiography imaging as a guideline.

Objectives: The aim of this study to evaluate the accuracy of zygomatic arch reduction by using of portable wireless dental X-ray with an intraoral sensor.

Methodology: This study comprised 15 patients who had isolated zygomatic arch fractures. The study was conducted between February 2021 and September 2022 in the department of oral and maxillofacial surgery at Alwasity Teaching Hospital, with patients ranging in age from 21 to 43. All cases were treated by closed reduction with the use of portable wireless dental X-ray with an intraoral sensor to ensure the reduction intraoperatively.

Results: Three months postoperatively all patients were sent for a new CT scan, we found excellent reduction and bone healing at the fracture site, except only one case was reveal slight depression at the fracture site but was esthetically accepted.

Conclusion: intraoperative use of portable wireless dental X-ray with an intraoral sensor is considered a safe, relatively easy, reliable method in the treating of zygomatic arch fracture.

Keywords: Facial bone fracture, Zygomatic arch fracture, closed reductions of zygomatic arch fracture, Gilles approach, Portable wireless dental X-ray with an intraoral sensor.

How to Cite: Falih, M., Zayed , A. S., & SafeAllah, M. (2023). Intraoperative use of portable wireless dental x-ray with an intraoral sensor as a guide in reduction of isolated zygomatic arch fractures. *Kufa Journal for Nursing Sciences, 13*(1), 147–154. https://doi.org/10.36321/kjns.vi20231.12146

INTRODUCTION

The zygomatic process of the temporal bone and the temporal process of the zygomatic bone union to form the zygomatic arch. Fracture of the arch can occur as a part of ZMC (zygomaticomaxillary complex) fracture or as an isolated form [1]. The isolated arch fracture results in facial asymmetry due to decreased face width or restricted mouth opening and is produced by lateral force directly over the arch [2]. The prevalence of an isolated zygomatic arch fracture is 5%–10% among all facial injuries [3]. Clinically, isolated displacement fractures of the zygomatic arch typically result in lateral facial depression, asymmetric facial width reduction, and clinical cheek flattening. Due to its favorable effects on face width and role in cheek projection, arch projection is a vital aspect of facial aesthetics. In order to improve facial aesthetics, displaced arch fractures should be corrected; however, if trismus or coronoid impingement is not present, correction is not necessary immediately [4]. Unfortunately, 45% of the cases of zygomatic arch fracture complain of limited mouth opening [5]. several imaging techniques such as a plain radiograph (submentovertex, occiptomental view), computed tomography, and cone beam computed tomography were used to confirm the diagnosis. Nowadays, Özyazgan et al. classification of zygomatic arch fractures is the most commonly used. It is categorized into two main types: type I, isolated zygomatic arch fractures; type II, combined zygomatic arch fractures and malar fractures. Type I either dual fractures (type I-A) or more than two fractures (type I-B). Type I-B is subdivided into V-shaped fracture (type I-B-V); and displacement fracture (type I-B-D) [6]. The isolated nondisplaced fracture may be managed conservatively, while displaced zygomatic arch fractures are typically treated surgically, with or without fixation. If displaced fractures are not repaired within two weeks, there may be functional and aesthetic issues [7]. Such fractures are treated by closed reduction either through extraoral (Gillies temporal) or through intraoral (Keen's and Quinn's) approach [8], or treated by open reduction and internal fixation through the bicoronal approach [9].

In this study, the indirect Gillies approach was used to reduction the zygomatic arch fracture, and a portable wireless dental X-ray with an intraoral sensor (zygomatic arch view) as a guide for evaluating the accuracy of reduction.

METHODOLOGY

This study was conducted in periods between February 2021 to September 2022 in the Department of Oral and Maxillofacial Surgery at AL Wasity Teaching Hospital. The study was conducted in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) and was approved by the institutional review board. Before the surgical procedure, patients' full case histories and signed informed consent were obtained.

The study population consisted of 15 patients,12 males, and 3 females with the age ranging from 21-43 years. all patients with isolated displaced zygomatic arch fractures who were systemically healthy and willing to return for follow-up were included in the study. Patients with combination fractures, undisplaced zygomatic arch fractures, systemic disorders, or those unwilling to return for follow-up were excluded from the study. closed reduction using Gillie's temporal approach was used in all cases. Preoperatively all patient was sent for a computed tomography CT scan to determine the size, type, and degree of zygomatic arch displacement (Fig 1). Intraoperatively we use a portable wireless dental x-ray with an intraoral sensor to ensure accurate zygomatic arch reduction (Fig 2). 3 months postoperatively all cases send for a new CT scan to evaluate the bone healing, and zygomatic arch reduction and evaluate the effect of using portable wireless dental X-ray with an intraoral sensor Intraoperatively (Fig 3).

Surgical Procedure:

All the patients were operated on under general anesthesia after the routine laboratory investigations and pre-anesthetic checkups had been done. Before the surgical incision, a portable dental X-ray with an intraoral sensor was used to determine the fracture site. the intraoral sensor is placed obliquely in the upper buccal vestibule facing the zygomatic arch and fixed in position by the index finger of the surgeon’s assistant. the surgeon stands behind the patient’s head and holds the portable wireless dental X-ray at an angle of 20-30 degrees from the temporal region and perpendicular to the intraoral sensor. Then take a shoot to ensure the fracture site of the zygomatic arch. After that Gillies’s incision was determined, approximately 2.5cm above and 2.5cm anterior to the helix of the ear. The superior temporal artery's bifurcation would serve as a marker for the incision. After local anesthetic with xylocaine was injected at the surgical site, a 2.5cm incision was made above the bifurcation of the superficial temporal artery from anterosuperior to posteroinferior direction.

The temporalis fascia is a white, glistening surface that was seen after making the incision into the skin and subcutaneous tissue. To reveal the temporalis muscle, a second incision was performed into the temporalis fascia. The next step was to place a Bristow elevator under the deep temporalis fascia and above the temporalis muscle. It was then swept anteriorly and posteriorly as the tip was advanced inferiorly until the medial portion of the zygomatic arch and the infratemporal surface of the body of the zygoma were reached. Due to the lack of a dense attachment between the temporal muscle and temporal fascia, the elevator could move freely in this plane. the periosteal elevator was removed after performing its function and Rowe’s zygomatic elevator was then placed medial to the zygomatic arch.

The internal handle was being utilized to stabilize the operative blade position while, the external handle was raised firmly to provide force in the anterior, superior, and lateral directions. The elevation of the arch was accompanied by an audible crunch or a cracking sound. Usually after reduction external palpation the contour of the malar and comparison with the opposite normal side to confirm reduction. But in this study, a portable wireless dental x-ray with an intraoral sensor was used again to evaluate and confirm the zygomatic arch reduction and repositions. Finally, the temporal incision was sutured by two layers, and the extraoral dressing was applied.

RESULTS

In this study, we observed 15 isolated zygomatic arch fractures,12 male and 3 female, the male-to-female ratio was 4:1. The left zygomatic arch was the most often affected site in 12 cases (80%); while the right zygomatic arch was only involved in 3 cases (20%). The range of ages was 21 to 43 years, 20% of the patients were under the age of 25y, 60% were between the ages of 26 and 36y, and 20% were between the ages of 37 and 43y.

The assault was the most common cause of zygomatic arch fracture (8 cases), followed by sports injuries (5 cases), and only 2 cases by road traffic accidents (Table I). All patients were treated by indirect reduction of the zygomatic arch through Gillies’s temporal approach. A portable wireless dental X-ray with an intraoral sensor was used for all cases, it enabled us to confirm the reduction of the zygomatic arch intraoperatively. Three months postoperatively all patients were sent for new CT scans, we found excellent reduction and bone healing at the fracture site, except for only one case, was reveal slight depression at the fracture site but was esthetically accepted.

DISCUSSION

One of our study's most significant findings was the disparity between the incidence of zygomatic complex fractures in males and females. Most studies found that males predominate among this patient population, which is a relatively consistent finding. The fact is that males drive more frequently generally, especially on highways [10]. Males also frequently engage in interpersonal violence and other physical contact sports like basketball, soccer, and others [11]. In the current study, the age between 26 to 36 years had the highest prevalence of zygomatic arch fracture (60% of cases).

Also, assaults were the most common cause of zygomatic arch fracture, followed by sports injuries and only 2 cases of road traffic accidents. This coincides with Hindin., et al. 2017 who have reported the assault to be the most common cause of zygomatic arch fracture [2].

Due to its prominence, the zygomatic arch is easily broken, which can cause cosmetic asymmetry, enophthalmos, dystopia, and trismus if the arch impinges upon the coronoid process [12]. There are various methods for reducing zygomatic arch fractures. Of these, are the Gillies approach, Keen approach, coronal incision, and direct overlying incision.

In this study, all patients were treated by indirect reduction of the zygomatic arch through the Gillies temporal approach. This approach is simple, with no facial scar, and a less traumatic approach. Most surgeons are often favored because they are easy to perform, result in no obvious scar, and involve a low possibility of facial nerve damage or direct trauma to the globe [13].

But the drawbacks of this approach relied on palpation solely and there was a possibility of improper reduction, which could be caused by the difficulty in visual confirmation of the fracture line, which originated from the masking effect of a swollen cheek [14]. In an attempt to get over these limitations, many surgeons have developed various techniques for identifying the dislocation site and determining how much of the zygomatic arch has been reduced.

Westendorff et al. used CT-based surgical navigation as a technique for fracture reduction and evaluation of fractures [15]. but was not extensively used due to the high cost and radiation exposure.

In this study, a Portable wireless dental X-ray with an intraoral sensor was used for all cases, it enabled us to diagnose the fracture site and confirm the reduction of the zygomatic arch Intraoperatively to decrease the possibility of malalignment or insufficient reduction of the arch. The intraoperative handling of the system was noninvasive, risk-free, quick, and easy modality. and unexpansive in comparison with other systems. On average, the device application, scan process, device removal, and data evaluation took less than 20 minutes.

CONCLUSIONS

The use of portable wireless dental X-ray with an intraoral sensor is a safe, relatively easy, reliable method, and low radiation dose. Also, it plays an adjunctive role in treating isolated zygomatic arch fractures by allowing the immediate monitoring of the adequacy of fracture reduction.

REFERENCES

1. Johner JP, Wiedemeier D, Hingsammer L, Gander T, Blumer M, Wagner ME. Improved results in closed reduction of zygomatic arch fractures by the use of intraoperative cone-beam computed tomography imaging. *Journal of Oral and Maxillofacial Surgery*. 2020 Mar 1;78(3):414-22.
2. Hindin DI, Muetterties CE, Mehta C, Boukovalas S, Lee JC, Bradley JP. Treatment of isolated zygomatic arch fracture: improved outcomes with external splinting. *Plastic and reconstructive surgery*. 2017 May 1;139(5):1162e-71e.
3. Kelamis JA, Mundinger GS, Feiner JM, Dorafshar AH, Manson PN, Rodriguez ED. Isolated bilateral zygomatic arch fractures of the facial skeleton are associated with skull base fractures. *Plastic and reconstructive surgery*. 2011 Oct 1;128(4):962-70.
4. Reyes JM, Ocampo SZ. Functional Classification of Isolated Zygomatic Arch Fracture: New Proposal.

Journal of Craniofacial Surgery. 2021 Mar 1;32(2):757-8.

5. Adam AA, Zhi L, Bing LZ, Zhong Xing WU. Evaluation of treatment of zygomatic bone and zygomatic arch fractures: a retrospective study of 10 years. *Journal of maxillofacial and oral surgery*. 2012 Jun;11(2):171-6.
6. Özyazgan I, Günay GK, Eskitaşçıoğlu T, Özköse M, Çoruh A. A new proposal of classification of zygomatic arch fractures. *Journal of oral and maxillofacial surgery*. 2007 Mar 1;65(3):462-9.
7. Cohn JE, Othman S, Bosco S, Shokri T, Evarts M, Papajohn P, Zwillenberg S. Management of Isolated Zygomatic Arch Fractures and a Review of External Fixation Techniques. *Craniomaxillofacial Trauma & Reconstruction*. 2020 Mar;13(1):38-44.
8. Dhungel S, Singh AK. Use of ultrasonography in reduction of isolated zygomatic arch fracture. *Journal of Chitwan Medical College*. 2020 Jun 25;10(2):59-62.
9. Birgfeld CB, Mundinger GS, Gruss JS. Evidence-based medicine: evaluation and treatment of zygoma fractures. *Plastic and Reconstructive Surgery*. 2017 Jan 1;139(1):168e-80e.
10. Montovani JC, Campos LM, Gomes MA, Moraes VR, Ferreira FD, Nogueira EA. Etiology and incidence facial fractures in children and adults. *Revista brasileira de otorrinolaringologia*. 2006;72:235-41.
11. Ungari C, Filiaci F, Riccardi E, Rinna C, Iannetti G. Etiology and incidence of zygomatic fracture: a retrospective study related to a series of 642 patients. *Eur Rev Med Pharmacol Sci*. 2012 Oct 1;16(11):1559-62.
12. Evans GR, Daniels M, Hewell L. An evidence-based approach to zygomatic fractures. *Plastic and reconstructive surgery*. 2011 Feb 1;127(2):891-7.
13. Adam AA, Zhi L, Bing LZ, Xing WU. Evaluation of treatment of zygomatic bone and zygomatic arch fractures: a retrospective study of 10 years. *J Maxillofac Oral Surg*. 2012;11(2):171-176.
14. Kim JS, Park YJ, Lee YJ, Kim NG, Lee KS. Reduction of zygomatic arch isolated fracture using ultra sound and needle marking. *Archives of Craniofacial Surgery*. 2016 Dec;17(4):198.
15. Westendorff C, Gülicher D, Dammann F, Reinert S, Hoffmann J. Computer-assisted surgical treatment of orbitozygomatic fractures. *Journal of Craniofacial Surgery*. 2006 Sep 1;17(5):837-42.

FIGURES AND TABLES

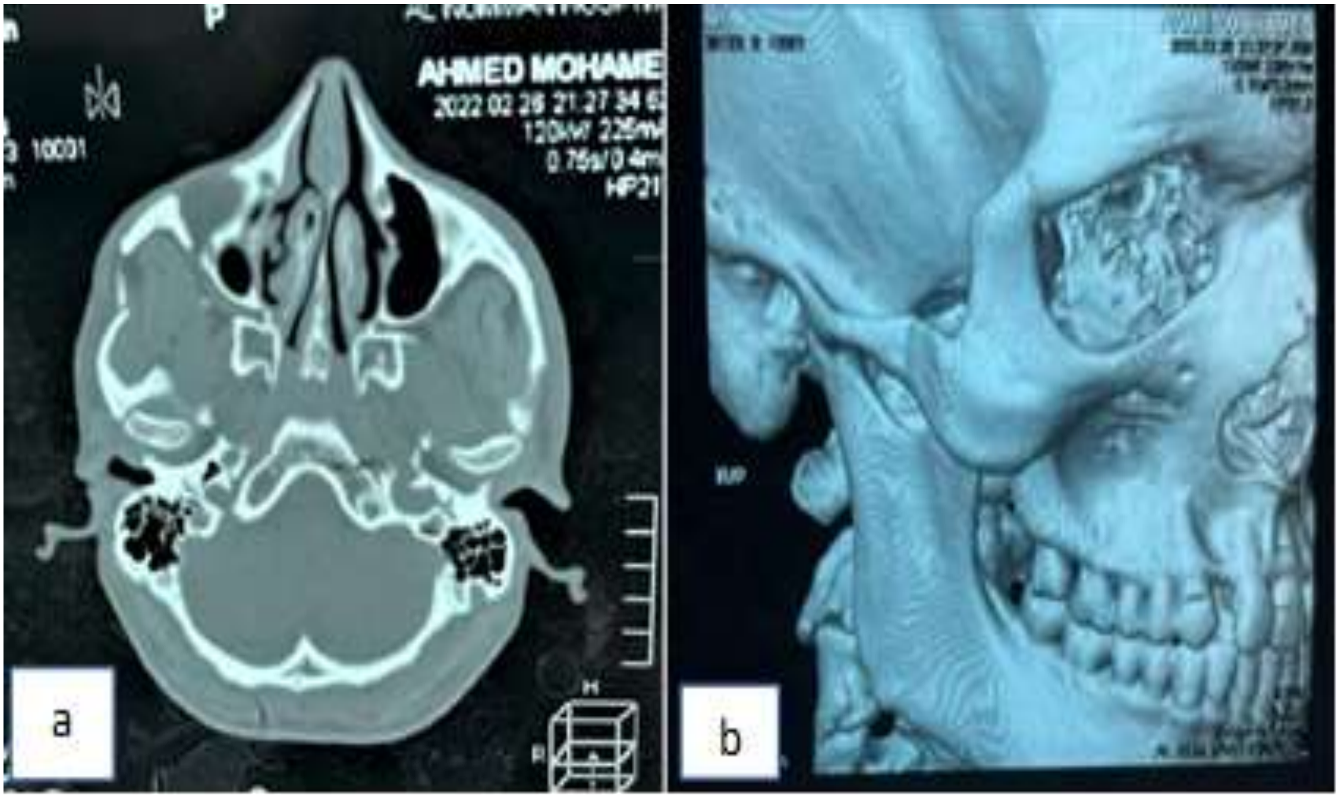

Figure (1): A: preoperative CT scan (axial view) showing right side zygomatic arch fracture. **B**: 3D views showing right side zygomatic arch fracture**.**

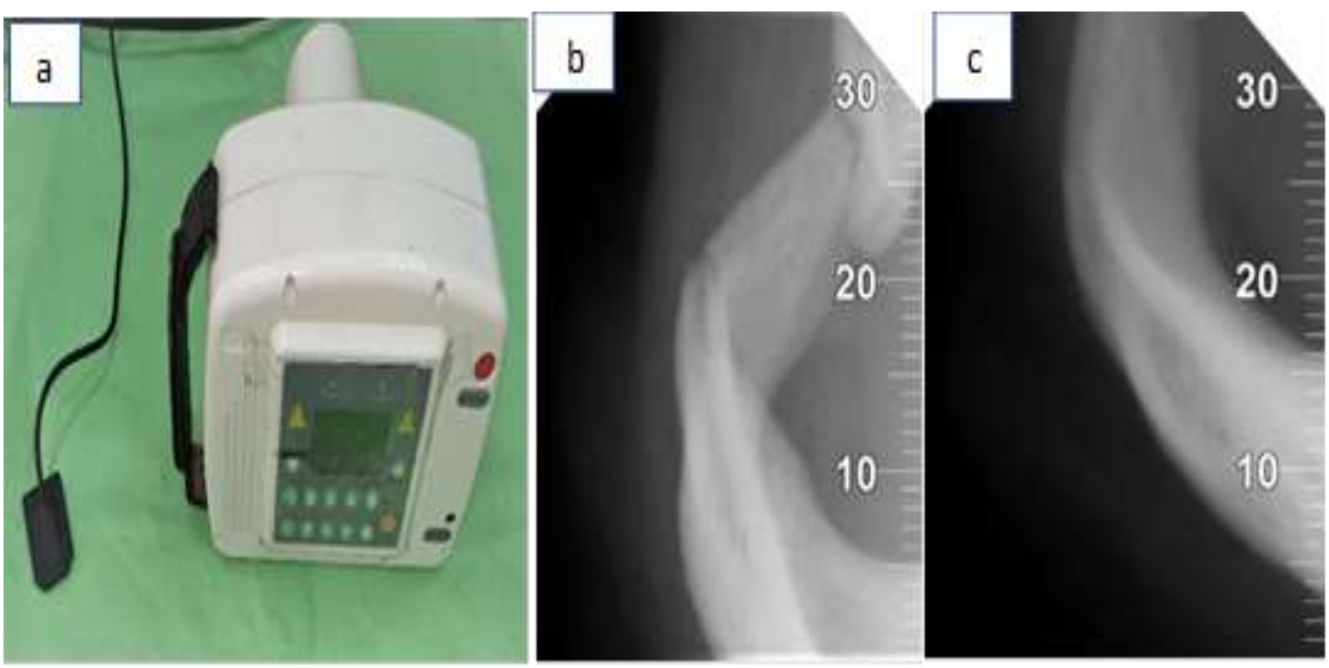

Figure (2): A: Portable wireless dental x-ray with the intraoral sensor. **B**: intraoperatively portable wireless dental x-ray reveals right side zygomatic arch fractures. **C**: intraoperatively portable wireless dental x-ray reveals zygomatic arch reduction.

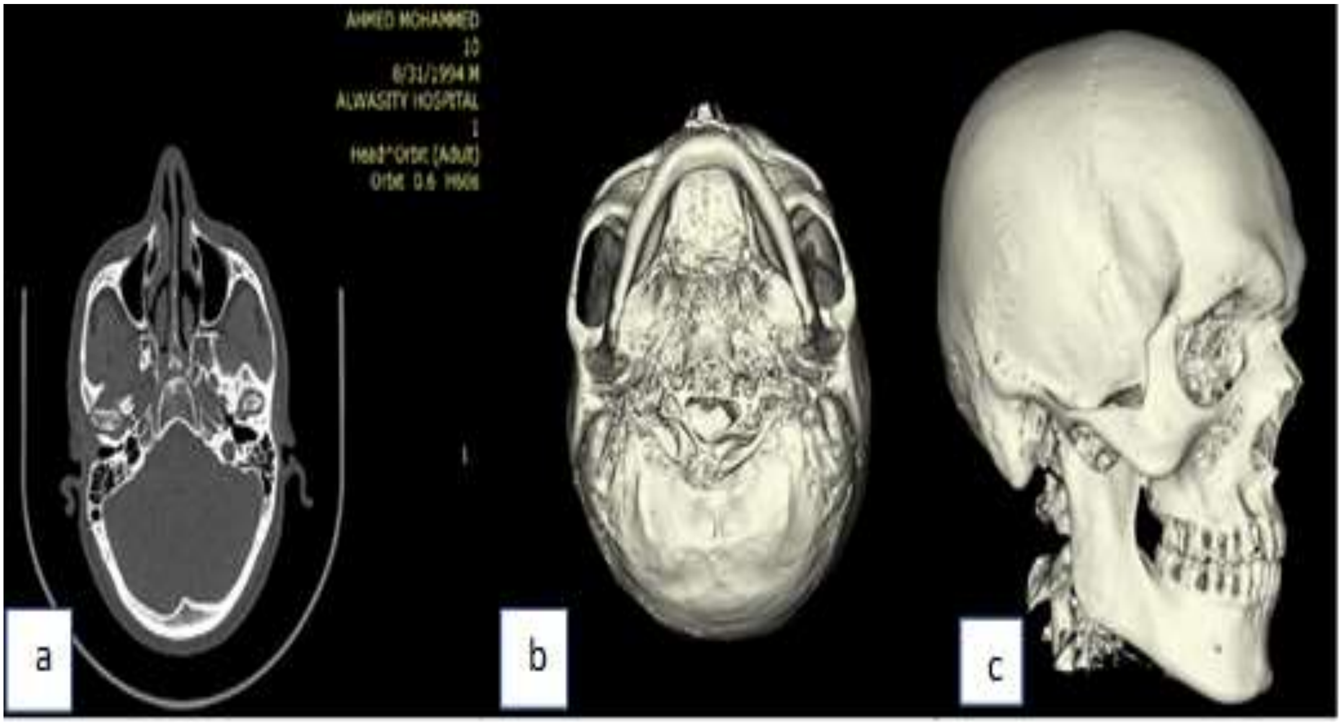

Figure (3): A: Axial view. **B:** 3D inferior view. **C:** 3D lateral view. 3 months postoperatively CT scan reveal bone healing at the fracture site and accurate right-side zygomatic arch reduction.

Table (1): Distribution of patients with isolated zygomatic fractures according to age, gender, side, mechanism of injury, type of fracture, and the postoperative outcome.

Patient no.	Age	Gender	Mechanism of injury	Fracture side	Type of zygomatic arch fracture according to Özyazgan et al classification by using CT scan	Surgical approach	Reduction and bone healing 3 months postoperatively
1	27	Male	Assault	Left side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
2	38	Male	Sport injury	Left side	Type I-A	Gillies approach	Excellent reduction and bone healing
3	30	Female	Assault	Right side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
4	21	Male	Sport injury	Left side	Type I-B-D	Gillies approach	Excellent reduction and bone healing
5	43	Male	Assault	Left side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
6	29	Male	Sport injury	Right side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
7	26	Female	Road traffic accident	Left side	Type I-B-D	Gillies approach	Good bone healing but slight depression at the fracture site
8	31	Male	Assault	Left side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
9	33	Male	Assault	Left side	Type I-B-D	Gillies approach	Excellent reduction and bone healing
10	28	Male	Assault	Left side	Type I-A	Gillies approach	Excellent reduction and bone healing
11	24	Male	Sport injury	Left side	Type I-B-D	Gillies approach	Excellent reduction and bone healing
12	30	Female	Sport injury	Left side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
13	29	Male	Assault	Left side	Type I-B-V	Gillies approach	Excellent reduction and bone healing
14	40	Male	Road traffic accident	Right side	Type I-B-D	Gillies approach	Excellent reduction and bone healing
15	21	Male	Assault	Left side	Type I-B-V	Gillies approach	Excellent reduction and bone healing